Problem Set #5 due beginning of class, Tuesday, Nov. 1. Remember to start each question with a description of what concept is central to your strategy and *why*. Don't forget your 4 lenses

1. Please do exercise 5 in 5.0 Centripetal Acceleration.

2. Please do Exercise 2 in 5.2 Inverse Square Relationship

3. Please do Exercise 1 in 5.2 Inverse Square Relationship

4. You need to build a massive slingshot that propels a 100 kg object (you in a capsule) at 13 km/s so you can go into space (infinity)! For ***each question***, start with a statement of which of the 4 mechanics concepts is central to this problem and why.
   a) How fast will you be going when you get to deep space?
   b) How fast will you be going when you are 1 earth radius above the earth's surface?
   c) If you passed near the moon, what effect would this have on your speed? I'm just looking for *speed* here. Direction is not what I'm asking about. Support your answer with a concept.
   d) If your slingshot is a massive spring that compresses 10 m, please find the spring constant that gives you this speed.
   e) What would be the maximum acceleration of your body at launch? How would this work for you?
   f) We learned from the video that the escape velocity from earth is about 11 km/s. Please look up the appropriate dimensions of the moon and find the escape velocity from the moon's surface.

5. There are two planets with centers 10^6 m apart: Planet A, and Planet B. The radius of Planet A is twice that of planet B, or $r_A=2r_B$. Both planets are made of the same rocks, and therefore have the same density. There are no other objects, so we are only looking at the force of gravity acting between the two planets. *Provide reasons for your answers before showing the work, before showing the answer.*
   a) What is the ratio of the masses of the planets? $m_A=\_\_m_B$.
   b) What is the ratio of the gravitational force attracting each of the two planets? $F_A=\_\_F_B$.
   c) What is the ratio of the acceleration of each object due to gravitational acceleration? $a_A=\_\_a_B$.
   d) I want to put myself between the two planets so that there is no force acting on me. That is, the force of gravity from each planet should be equal and opposite. What should be the ratio of these distances (from the center of the planets)? $x_A=\_\_x_B$
   e) I want to put myself between the two planets such that my gravitational potential energy due to each planet is the same. What should be the ratio of these distances (from the center of the planets)? $x_A=\_\_x_B$
   f) Find x_A (my distance from the center of planet A) in meters for question d) and for question e)
   g) Starting from rest, I let the planets fall together. When they hit, what is the ratio of the two speeds? $v_A=\_\_v_B$ be careful to identify which of the 4 concepts is at play here, what must be the same for them?
   h) For question g above, can you calculate where they will hit each other? Is it half way between where the two plants' original positions or not?

6. Do Exercise 2 in 5.3 Loop the Loop, circular motion in the vertical plane.